AN INVESTIGATION OF GHANAIAN JUNIOR SECONDARY SCHOOL MATHEMATICS TEACHERS' CONCEPTIONS OF MATHEMATICS AND ITS TEACHING

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ABSTRACT

This article discusses a study of Junior Secondary School (JSS) mathematics teachers' conceptions of, and beliefs about, mathematics and its teaching. A questionnaire was developed and distributed to teachers of mathematics in 75 JSS's drawn from 5 educational circuits of Winneba District, Ghana. Four conceptions of mathematics and four of mathematics teaching were identified. The study indicated that teachers tend to possess disparate conceptions of mathematics and its teaching. It is argued that the possession of diverse conceptions may be a consequence of cultural and curricular ambiguities in respect of mathematics teaching in Ghana. Some implications in respect of teachers being able to fulfil Ghanaian National Curriculum requirements are discussed.

KEYWORDS

conceptions of mathematics, conceptions of mathematics teaching, curriculum determination, junior secondary schools,

INTRODUCTION AND PROBLEM STATEMENT

This study originates from a perception, based on the author's experiences that pre-service and serving teachers of junior secondary mathematics teachers have widely differing conceptions of the subject, which influence the ways in which they teach. Moreover, the requirements of the Ghanaian National Curriculum for Mathematics (CRDD, 2001) may favour some perspectives or beliefs over others – a conjecture supported by critiques such as Awanta and Asiedu-Addo (2005). These concerns urged the researcher to investigate systematically the veracity of mathematics teachers' perceptions and their implications.

However, a discussion of earlier work in respect of teachers' conceptions of mathematics would be misplaced without a consideration of the generic literature pertaining to beliefs and conceptions. This is particularly apposite when differing descriptive frameworks found in the literature (Awanta and Asiedu-Addo, 2005; Abelson, 1979; Tabachnik and Zeichner, 1984; Clandinin and Connelly, 1987; Nespor, 1987; Goodman, 1988; Pajares, 1992) are set against Thompson's (1992) (a key figure in the debate concerning teachers' conceptions of mathematics) argument that such constructs, in spite of their importance in predicting behaviour, have been inadequately defined in the educational literature because 'researchers have assumed that readers know what beliefs are' (Thompson, 1992, p. 129).

Objectives of the Study

The purpose of this study was to explore teacher conceptions of mathematics, their conceptions of mathematics teaching and its classroom manifestations and to explore any relationships between them. The work has been informed significantly by Ernest's (1989) and Lerman's (1990) descriptions – primarily because they resonate with my perceptions of teachers and their practices, and by Munby's (1982) comments that:

> *while subscribing to the view that our beliefs construct our experience, it is necessary to recognise that individually we may not be the best people to clearly enunciate our beliefs and perspectives since some of these may lurk beyond ready articulations. (p. 217)*

LITERATURE REVIEW

A detailed account of the nature of beliefs is beyond the scope of this article – this can be found in Pajares (1992). However, it is appropriate to consider, if only briefly, their significant and generally agreed characteristics. Abelson (1979) and Nespor (1987) describe four broad defining characteristics. Beliefs may pertain to the existence of entities outside the believer's control; they may represent an idealistic alternative world, a person's episodic experiences. Da Ponte (1994) describes beliefs as 'the inconvertible personal 'truths' held by everyone, deriving from *experience* or from fantasy, having a strong affective and evaluative component' (p. 199).

Many researchers discuss *belief systems*, which Thompson (1992) describes as organising structures. Awanta *et al.,* (2004) identified a belief system: the generalist approach, where mathematics is believed to be a subject that could be taught and learned by a person who was interested in it. This generalist approach was reflected in

the form of confidence in teaching practices and belief about pupils' learning. Green (1971) writes that beliefs are never held independent of other beliefs, with the consequence that belief systems contain both primary and derivative beliefs. Beliefs in a system are either central or peripheral, with the former being least susceptible to influence. Beliefs are held in clusters that may be held in isolation from other clusters, thus making it possible to hold apparently conflicting beliefs. Da Ponte (1994, p.199) adds that 'belief systems do not require social consensus regarding their validity or appropriateness. Personal beliefs do not even require internal consistency. Da Ponte (1994) writes that conceptions are the underlying organising frames of concepts and are, essentially, cognitive in nature. He argues that both beliefs and conceptions are part of knowledge, with conceptions conditioning 'the way we tackle tasks, very often in forms that others find far from appropriate'. Thompson describes a 'teacher's conceptions of the nature of mathematics as that teacher's conscious or subconscious beliefs, concepts, meanings, rules, mental images, and preferences concerning the discipline of mathematics. Those beliefs, concepts, views, and preferences constitute the rudiments of a philosophy of mathematics' (Thompson, 1992, p. 132).

Researches suggest that many teachers begin their careers with previously constructed, often naïve and possibly subconscious theories about teaching (Awanta and Asiedu-Addo, 2005; Powell, 1992), which are frequently modelled on recollection of teachers who taught them (Feiman-Nemser and Buchmann, 1986; Calderhead and Robson, 1991; Harel, 1994). Furthermore, as Clark (1988) suggests, teachers continue to hold idiosyncratic theories throughout their careers. In Ghana there are, in general, three ways by which a person might become a professional teacher. Firstly, there are three-year post-secondary initial teacher training colleges, where one is enrolled and completes with an award of Teachers' Certificate 'A'. Secondly, one could enrol directly into Teacher Education tertiary institution (either University of Education, Winneba or University of Cape Coast, Cape Coast). A third option requires prospective teachers to hold a degree in a non-teacher education university and enrol for a one-year postgraduate diploma in education (PGDE) either at the University of Education, Winneba or the University of Cape Coast, Cape Coast. An interpretation of this leads to a process of quantification whereby the diploma becomes an acceptable qualification. Thus, for example, graduates in mathematics, engineering, accountancy or computer science become acceptable entrants to the teaching profession. The last one-decade has seen a substantial contraction of Ghana's industry base. Consequently, many applicants for teacher training are mature, with career experiences, which are likely to have informed their perspectives on mathematics in ways beyond those of the class or lecture room. Such experiences, according to Harel (1994), create problems for teacher education because 'it is not possible for prospective teachers to change their beliefs and conceptions about mathematics they have formed during a long period of time' (p.115). Indeed, Foss & Kleinsasser (1996) found that teachers' conceptions of teaching are greatly informed by their experiences as consumers of school and are likely to remain constant throughout their courses of professional preparation.

However, as Richardson (1994) notes, unless teachers examine their beliefs they may perpetuate questionable practices based on dubious theoretical foundations. Therefore, one role of the teacher educator should be to facilitate trainees' acknowledging their perspectives. This requires that their theories be 'revealed so that they can be scrutinised, challenged, compared to public theories, and then confirmed or

reconstructed' (Griffiths and Tann, 1992, p. 71). Also, unless trainees are given the opportunity to reflect meaningfully on their experiences (McCutcheon and Jung, 1990), it is unlikely that they will construct theory appropriate to their circumstances. It is important, also, that teacher educators acknowledge that no two teachers are entirely alike because 'the ways they approach the tasks of teaching, their reflections on that teaching, their relationships with students and peers are highly personalised' (Alexander *et al.*, 1992, p. 59). Indeed, such diversity is confirmed by the variety of metaphors teachers use to describe their roles (Munby and Russell, 1990). It was against such findings and my experiences of working with, in particular, trainee teachers of diverse backgrounds that this study was framed.

In respect of mathematics, Ball (1991) cites early research indicating that many of the variables, like teachers' understanding of mathematics itself, were rarely found to influence children's learning. Later research recognised the complexity of the problem and focussed on teachers' thinking and professional decision-making (Clark and Yinger, 1979). Ernest (1989), however, has argued that much of the research into teachers' psychological processes has ignored 'the thought structures of the teacher, the knowledge, beliefs and attitudes stored as schemas in the mind of the teacher' (p. 13). This would appear a not insignificant omission when considered against Thom's (1973) perception that 'all mathematical pedagogy, even if scarcely coherent, rests on a philosophy of mathematics' (p. 204).

In general, despite evidence that teachers' beliefs inform practice, little research has been undertaken in respect of determining the nature and depth of teachers' beliefs (Nespor, 1987; Pajares, 1992). In particular, the exploration of teachers' conceptions of mathematics is a relatively recent phenomenon (Thompson, 1984), although her more recent review of the literature led to her to conclude that 'teachers' beliefs about mathematics and its teaching play significant role in shaping teachers' characteristic patterns of instructional behaviour' (Thompson, 1992, pp. 130-131), a conclusion supported by other, largely case study, evidence (Thompson, 1984; Lerman, 1990).

Blaire (1981) suggests that mathematics teaching can be classified according to whether teachers perceive the subject as an art form, a game, a natural science, or technologically oriented. He outlines his perception that the latter is the desirable because of its satisfying the needs of a greater number of vested interests than the others. Ernest (1989) offers six models of teachers' conceptions of mathematics teaching – the pure investigational; problem posing and solving model; the conceptual understanding enriched with problem-solving model; the master of skills and facts model; the day-to-day survival model. He suggests that the 'importance of the teacher's mental model of mathematics teaching is that it is the key determinant of how mathematics is taught' and 'is likely to be closely related to and influenced by the teacher's conception of the nature of mathematics (pp. 22-23).

Thompson (1992), whilst acknowledging Ernest's (1989) contribution, cites work by Kuhs and Ball (1986) which identified four models of mathematics teaching: learner-focused, concept-focused with an emphasis on conceptual understanding, content-focused with an emphasis on performance, and classroom-focused. She argues that the first three models resonate closely with Ernest's three conceptions of mathematics.

The fourth assumes that the content to be covered is outside the control of the teacher whose only task is to present the material in acceptable ways according to 'effective teacher behaviours identified in process-product studies of teaching effectiveness' (p. 137). The latter, which have been 'presented under the rubric of research-based teacher education' (Beyer, 1987, p. 20) have focused on the:

> *Development of specific teaching skills or teaching strategies apart from considerations of the curricular context within which the skills are to be employed or the ends towards which they are to be directed. The effect of these programmes has been to trivialise the relationship between teacher and learner by assigning to the teacher the role of technical, value-free behaviour manager.* (p. 20)

The purpose of this study, as stated earlier (see the subheading "Objectives of the Study") therefore seems to reflect the contemporary literature, which has been reviewed on teachers' conceptions of mathematics, their conceptions of mathematics teaching and its classroom manifestations.

This study has been informed by Fenstermacher's (1978) statement that conceptions are 'accessible only by inference' (p. 103) and Lerman's (1990) comments that research in such areas has tended to polarise between 'top-down', in essence hypothetico-deductive, and 'bottom-down', primarily inferential, approaches; the former starting 'from a consideration of the current state in the philosophy of mathematics' and the latter beginning with 'teachers' views and behaviour' (p. 53).

It has also been informed by Awanta *et al.*'s (2006) study, which investigated an experienced teacher's perception of the nature of mathematics and its implication in teaching practices. The study found that 'self-concept' in both the teacher and pupils plays a very significant role in supporting the teaching and learning processes in mathematics.

METHODOLOGY

This study incorporates surveys of teachers of mathematics at the Junior Secondary School (JSS) level and interviews with volunteers drawn from the surveys. Survey research is concerned with the measurement of 'elusive phenomena that cannot be observed directly' (De Vellis, 1991. p. 51), of which conceptions and beliefs are examples (Ajzen, 1988). Self-completed structured questionnaires are perceived to be an appropriate means of effecting such measurement (Mouly, 1978; Judd *et al*., 1991) because they provide a scale on which one can assess, usually quantitatively, the individual's performance or standing on the attribute in question' (Robson, 1993, p. 255).

A four-section questionnaire was devised to explore aspects of teachers' conceptions of mathematics and its teaching. These were their conceptions of mathematics, their conceptions of mathematics teaching, their perceptions of their own classrooms, and their topic preferences in respect of their teaching. A pilot was developed, in consultation with colleagues, and trialled on an opportunity sample of 40 teachers of

JSS mathematics undertaking pre-entry mathematics course at the department of mathematics education, University of Education, Winneba. The questionnaire was revised in the light of their responses and a final version constructed. An important consideration was a decision to abandon Likert-like scales in favour of a pseudo-continuous scale for each item. This was for two reasons: a continuum might encourage respondents to show a greater degree of circumspection than otherwise might be the case and respondents who normally avoided identifying with either pole may have been cajoled into doing so. Further details of the questionnaire and its development can be found in Andrews and Hatch (1977) as in the reference of this study.

The final version was offered to volunteers from each of the educational circuits in Winneba District, Central Region. In all, 125 teachers volunteered from Winneba Circuit, 100 from Bawjiase Circuit, 85 from Kasoa Circuit, 55 from Senya Circuit and 35 from Bontrase Circuit. Full details of the numbers in each sampled circuit can be seen in Table 1 below.

Table 1: The number of respondents from each of the five sampled circuits

EDUCATIONAL CIRCUIT	NUMBER OF VOLUNTEERS
Winneba	125
Bawjiase	100
Kasoa	85
Senya	55
Bontrase	35
TOTAL	**400**

In addition, respondents were invited to complete a section concerning their qualifications, gender and length of service. Also sample teachers from Winneba, Bawjiase and Kasoa Circuits were invited for interview, of whom 52% volunteered. About 65 interviews have been conducted in Winneba and Bawjiase Circuits. No analysis of the interview data has yet been undertaken and this article reports only on the questionnaire analyses.

RESULTS

The results reported here are those findings believed to be of interest. The items of the questionnaire were subjected to an initial reliability analysis. This process determines the likelihood that should a reliability test be used on subsequent occasions, similar results might occur. An initial Cronbach alpha gave an acceptable 0.789. Litwin (1995, p.31) suggests that 0.7 or better is ‘generally accepted as representing good reliability’. When the sections concerning teachers’ topic preferences and biographical details were removed (these are to be analysed separately later), the Cronbach alpha was raised to 0.801.

The remaining items were subjected to factor analysis, which are statistical techniques 'used to identify a relatively small number of factors that can be used to represent relationships among sets of many interrelated variables' (Norusis, 1990, p. B-125). A factor analysis is an 'analytic tool that can … help us to determine empirically how many constructs, or latent variables, or factors underlie a set of items' (De Vellis, 1991, p.92). Generally, factor analysis is an inferential statistical procedure that is usually used with data from random samples. The sample used for this research was chosen on non-random basis (volunteers). Since more than two factors were suspected to emerge from the questionnaire responses, the researcher decided to use factor analysis. This is in line with Gay's (1992) assertion that if a research study investigates two or more independent factors and the interactions between them, the appropriate statistical analysis is factorial. The researcher was also convinced with the appropriateness of the use of factor analysis in this research because Child (1970) states that factor analysis is particularly appropriate where investigations aim to impose an 'orderly simplification' upon a number of interrelated factors.

In respect of determining the number of factors to extract, Thurstone (1947) recommends accepting those with eigen values in excess of 1 – described by Child (1970) as the Kaiser criterion. Goddard and Kirby (1976) and De Vellis (1991) suggest that the Kaiser criterion equates to accepting 'only those factors that account for more than their proportional share of the original variance' (Goddard and Kirby 1976, p.24). In this study, 10 factors were extracted. These are:

- An informal pedagogy focused on the **development of mathematical processes**.
- Mathematics conceived as a personal **economic tool**.
- Mathematics conceived as a **pleasurable** and diverse activity.
- A formal pedagogy focused on the development of **skills**.
- Pedagogy focused on children **working individually**.
- A conception of mathematics as a **life-tool**.
- Creation of mathematically **enriched** classroom.
- An open, cooperative and **collaborative** classroom.
- A conception of mathematics as a **service** tool to other forms of activity.
- **Curriculum determination**.

This article is concerned with the manner in which conceptions of mathematics might influence each other and how they might inform, and be informed by, beliefs about the teaching of the subject. Consequently the results are presented in three tables. The first (Table 2) shows the correlations between the four conceptions of mathematics described below. The second (Table 3) shows the correlations between the four constructs pertaining to mathematics teaching, and the third (Table 4) shows the correlations between conceptions of mathematics and its teaching.

The factors that emerged from the analysis maintained the integrity of the different sections of the questionnaire. That is, for example, items which were intended to explore teachers' conceptions of mathematics yielded constructs independent of those yielded by statements addressing classroom practice and or beliefs about the teaching

and learning of mathematics. A score was calculated for each teacher on each factor by obtaining the mean for all the items comprising that factor – including those, which had loaded on more than one factor.

Conceptions of Mathematics

Four factors were identified which could be described as representing a conception or understanding of, or perspective on, mathematics as an area of human activity. Mathematics was seen as a personal *economic tool* in the sense that it might facilitate a person managing his or her household accounts. It was viewed as an essential *life-tool* in the sense that an understanding of mathematics allows people to comprehend the world and make informed decisions. Mathematics was conceived as a *service provider* to other areas of human activity such as science, commerce, industry and technology and, as such, was seen as a collection of results, which were to be used rather than understood. Lastly, there was a conception that *curricular determination* was the prerogative of teachers rather than government.

Table 2: Correlations and their associated probabilities calculated between the four conceptions of mathematics identified by the factor analysis. Significant probabilities have been boldened

	Economic tool	Life-tool	Service
Life-tool	0.152		
	0.000		
Service	0.267	0.186	
	0.000	**0.000**	
Curriculum	-0.065	-0.076	-0.132
	0.119	0.067	**0.001**

As can be seen from the figures, mathematics as a service to other areas of activity correlated significantly with each of other three conceptions although it should be noted that the correlation with notions of curricular determination was negative. Mathematics as a *life-tool activity* correlated significantly with all except notions of *curricular determination*. Notions of *curricular determination*, as indicated, correlated significantly negatively with mathematics as a *service* to other areas of activity. However, the correlations between it and both mathematics as a personal *economic tool* and a *life-tool* were also negative.

Conceptions of Mathematics Teaching

Four conceptions of, or perspectives on, mathematics teaching were identified. Mathematics teaching was conceived as both a *process-oriented* and *skills-oriented*. There was a conception of mathematics teaching that addressed teaching as a *collaborative and cooperative* act. Lastly, there was a sense in which teachers subscribed to the importance of the creation of a *mathematically enriched* environment. Interestingly, the perspectives concerned with individualised instruction and collaboration were independent of any notions of mathematics and could be construed as generic conceptions of teaching.

Table 3: Correlations and their associated probabilities calculated between the four conceptions of mathematics teaching identified by the factor analysis. Significant probabilities have been boldened

	Process	Skills	Enriched
Skills	0.314		
	0.000		
Enriched	0.349	0.183	0.154
	0.000	**0.000**	**0.000**
Cooperative	0.385	0.010	0.198
	0.000	0.813	**0.000**

Mathematics teaching as a *process-oriented* activity and the creation of a mathematically *enriched classroom* environment correlated significantly positively with each of the other three constructs. Mathematics teaching as a *skills-oriented* activity correlated with all except the establishment of a *cooperative* and *collaborative classroom.* Thus, it can be seen that the creation of a *cooperative* and *collaborative classroom* correlated significantly positively with all except mathematics teaching as a *skills-oriented* activity.

Table 4: Correlations and their associated probabilities calculated between the four conceptions of mathematics and the four conceptions of mathematics teaching identified by the factor analysis. Significant probabilities have been boldened

	Process	Skills	Enriched	Cooperative
Economic tool	-0.030	0.038	0.006	-0.039
	0.468	0.360	0.894	0.346
Life-tool	0.254	0.378	0.192	0.063
	0.000	**0.000**	**0.000**	0.133
Service	0.103	0.109	0.028	0.068
	0.014	**0.009**	0.509	0.103
Curriculum	0.155	-0.087	0.020	0.054
	0.000	**0.037**	0.628	0.195

Whereas each conception of mathematics correlated with almost all other conceptions of mathematics, and each conception of teaching correlated with almost all other conceptions of teaching, the links between conceptions of mathematics and those of its teaching were less ubiquitous. For example, mathematics as a personal *economic tool* failed to correlate with any conception of teaching. Mathematics as a service to other areas of activity correlated with just two, teaching as both a *process-oriented* activity and as a *skills-oriented* activity. Indeed, every other conception of mathematics correlated, in addition to others, with teaching as both a *process-oriented* activity and as a *skills-oriented* activity. The only perturbation to this was that the correlation between notions of *curricular determination* and mathematics as a *skills-oriented* activity was negative. Mathematics as a *life-tool* also correlated with the creation of *mathematically enriched* classrooms.

DISCUSSION AND POLICY IMPLICATIONS OF THE STUDY

A questionnaire was developed with the intention of investigating aspects of Junior Secondary teachers' conceptions of mathematics and its teaching. The analysis confirmed that the questionnaire would produce similar results should it be replicated. Factor analysis identified 10 factors or constructs. Four were thought to access teachers' conceptions of mathematics and four conceptions of its teaching. In general, each section of the questionnaire, each of which had been developed for a particular purpose, yielded constructs independent of other sections, which, in so doing, conferred a sense of content validity upon them. The findings are believed to contribute significantly to the debate concerning teachers' conceptions of mathematics and its teaching. Moreover, it is believed that their descriptions will resonate with experiences of those familiar with the Ghanaian Junior secondary school mathematics classroom.

Conceptions of Mathematics

It is acknowledged that the results described here were determined, in some sense, by the questionnaire design and could not, therefore, be neutral or value-free. However, it is believed, and this is supported by the author's perceptions of himself as having fallibilist rather than absolutist conceptions of mathematics that the findings are of interest and demonstrate both the complexity and possible consequences of the conceptions teachers of mathematics have of the subject they have chosen to teach.

Mathematics as a *service*, with its focus on application rather than understanding, resonates closely with Ernest's (1989) notion of instrumentalism Teachers who favour such a conception, are likely to present the subject as a body of knowledge and rules which may be used to support work in areas other than mathematics itself.

Mathematics as a *life-tool* differs substantially from mathematics as a *service* in its presenting the subject as a means by which people might make sense of, and control, an increasingly complex world. There is an implicit acknowledgment that mathematics provides more than just the tools to facilitate everyday problem solving – it empowers the individual through higher levels of understanding than those acquired through rote learnt rules.

Mathematics as an *economic tool* is different again. It has a narrow focus and presents mathematics as a means by which individuals might maintain their household accounts and in so doing gain pleasure. The *curriculum determination* of mathematics, with its emphasis on teachers determining curriculum content, is the only conception of the four identified with no overt absolutist slant. That is, where teachers are granted responsibility for deciding curriculum content there is a more than implicit acknowledgment that the subject is not immutable and therefore, by nature, fallibilist and problem solving.

Conceptions of Mathematics Teaching

Process-oriented teaching, with its focus on discussion, investigation, group work and games, is commensurate with a conception of mathematics as a social construction. Mathematics teaching as *skills-oriented*, with its emphasis on the routine practice of skills and whole class teaching could be construed as an absolutist conception. Indeed, an argument could be constructed showing resonance with the absolutist teacher who

gives 'students routine mathematical tasks which involve the application of learnt procedures' (Ernest, 1989, p.451).

Mathematics teaching and the creation of a *cooperative and collaborative* classroom appears concerned with the establishment of those interpersonal classroom interactions which teachers believe scaffold children's learning. Such a conception, the author argues, is likely to be more fallibilist than absolutist. Fallibilist pedagogic traditions which favour discussion and teachers moving to children's tables run counter to absolutist notions of teacher-centred exposition and, if they move at all, children moving to the teacher's table. Interestingly, the *cooperative* classroom, like the individualised classroom, is a pedagogic perspective independent of mathematics as a subject of study. Lastly, the creation of a *mathematically enriched* classroom, as manifested by teachers placing posters, puzzles and reference materials on their walls, may be more indicative of a fallibilist perspective on mathematics teaching than absolutist. The act of posing puzzles or problems suggests a perspective on mathematics teaching that not just permits but encourages individuality of expression.

CONCLUSIONS

A study by Awanta (2005) found that practices of teachers seemed not to reflect the values and concerns entrenched in the Ghanaian mathematics curriculum standards. The teachers teach a prescribed mathematical content, which appears only loosely, related to a child's cognitive and chronological development. The basic school mathematics curriculum for Ghana presents mathematics as a diverse set of ideas, which, for the foreseeable future and despite its inherent ambiguities, must be seen as the gauge against which teachers are measured. The evidence of this study indicates that substantial numbers of serving teachers may have perspectives on mathematics, which counter the successful fulfilment of those curricular expectations. Amongst these would be teachers whose dominant conception of mathematics is as a *service* to other areas of activity. Their tendency towards teachers' telling and children's practising makes them less amenable than other teachers towards different pedagogic approaches militates against their students accessing the process elements of curriculum. Such tendencies also indicate that these teachers, whilst favouring whole class teaching, would be unlikely to work in ways believed to facilitate higher levels of attainment (Askew *et al*., 1997; Department for Education and Employment [DfEE], 1998).

In summary, the evidence indicates that the teachers hold simultaneously a variety of not necessarily consistent conceptions of, and beliefs about, mathematics and its teaching. However, the degrees to which such conceptions and beliefs are held vary subtly and the evidence suggests that such variations are likely to be consequences of deeper philosophical beliefs privileging a dominant perspective. The indications are that teachers' dominant pedagogic beliefs are inconsistent with their dominant perspectives on mathematics. Whatever its flaws and inconsistencies, the Ghanaian basic school mathematics curriculum document is the framework within which teachers must operate. The evidence of this study suggests that current curricular expectations are more likely to be fulfilled by teachers whose dominant perspectives lead them towards an awareness of, and pleasure in, the diverse nature of mathematics and its processes than those with instrumental beliefs in which the subject is viewed as a service to other areas of activity.

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